

## IMPLICATIONS OF THE METHODS OF CROP DIVERSIFICATION: A COMPARATIVE STUDY

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### ABSTRACT

*This paper aims to measure crop diversification for a uniform data set of 35 year for two districts of Rajasthan state of India namely Kota and Jaisalmer. At the same time it focuses on status and changing pattern of crop diversification in the districts with a comparative outlook of both. Data used for the study were collected from year 1980 to 2014 and whole study was divided in to five periods and separate analysis was done for all period. Herfindahl indexes, Simpson index and Index of maximum proportion were used to measure the crop diversification in the districts for comparative study. Results of the study shows complete diversification was found in the Kota district in all period through all index and likewise in Jaisalmer district crop specialization was found in first and second period through all indices, Moderate diversification was found in third and fourth period through all indices and finally complete diversification was found in firth period through all three indices in Jaisalmer district. During the study I was found that all indice provided same results for the both the district.*

**KEYWORDS:** High Value Commodities, Agro Ecosystems, Risk and Climate Change

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### INTRODUCTION

As we know that an economic development is very important for any growth of country and for raw material its depend on agriculture sector which serves as a food producer and factors-of-production supplier to industrial sector which is directly link with economic development. It is major source of income for rural households in less developed or developing economies. The well developing sector makes tremendous contribution to poverty and inequality reduction in out-of-the-way areas. In respect to above agricultural diversification has been considered one of the most likely avenues to promote the development of agriculture. it is the adjustment of farming, which combines various and complimentary agricultural activities and moves agricultural resources from low to higher value crop like from cereal to pulse to horticultural (fruits, vegetable and spice) (Meerta *et al.*, 2005; Joshi *et al.*, 2003; McCulloch and Ota, 2002; Delgado and Siamwalla, 1999; Seng, 2014).

By conventionally, agricultural diversifications referred to a subsistence kind of farming where in farmers or growers were cultivating varieties of crops on a piece of land and undertaking several enterprises on their farm portfolio to reduce the risk or failure of single activity. Basic objectives of agricultural diversification were household food and income security. (Abro, 2012).

In the third world countries like India crop diversification is a strong applied concept to eliminate the dilemma of subsistence agricultural economy and to ensure diversified nutrition status of the poor men of country. Meaning of crop diversification is rising of a variety of crops involving intensity of competition amongst field crops for arable or cultivable land. Right now there is need to move from crop specialization to crop diversification to reduce poverty and augment farm income. "The keener the competition, the higher the magnitude of the crop diversification and lesser the competition the greater will the trend toward specialization or monoculture farming where emphasis is on one or two crops" (Jasbir Singh 1976 ; Pal and Kar, 2012).

For creating enabling conditions for nurturing the process of crop diversifications and agricultural development there is need of some essential pre requisite of creation of basic infrastructural facilities like markets, persistent supply of irrigation facilities, availability of fertilizer, transportation and good roads (Acharya, *et al.*, 2011).

In South East Asia many countries have undertaken crop diversification to augment productivity and cultivate high value crops with positive outcome to meet up the challenges of a globalising market in agriculture as well as the growing and changing needs of the population. These countries are gradually diversifying their cropping pattern from low value crop (cereals) to high value crops especially from cereal to fruits, vegetables and spices. Diversification is taking place by a two way either through area augmentation or by crop substitution. Diversification can be used as a instrument to augment net farm income, reduce unemployment, reduce poverty and conserve water resources and valued soil (Pingali and Rosegrant 1995). This positive impact of diversification supported by study of Ramesh Chand 1996.

By the concept of crop diversification we can identify or understand the impact of socio-economic and physical conditions on the agriculture and its allied sector. In addition, it helps us in knowing the contemporary competition among crops for area, production, per hectare productivity, for rotation and effect on double cropping (Bhalsing, 2009).

The prevalence of crop diversification in India, on the other hand, before the introduction of new agricultural technology in the mid-sixties it was very uncommon. With the beginning of new agricultural technology particularly, water seed- fertilizer technology, a significant change in land allocation towards some high value cash crops such as fruits and vegetables cultivated by the small farmers is observed in India (Joshi *et al.*, 2006).

Indian agriculture is predominantly a small peasant based economy with approximately 80% of the operational holdings being below two hectares, and 34% of the agricultural land are cultivated by them (GOI, 1997; Pal and Kar, 2012). Because low operational holdings, it is really not easy by the small farmers to improve their earnings only by raising the yields of the existing crops by using crop specialization, mainly cereals. They should move on high value crops with available modern farm inputs may provide a stable economic base of the poor peasants (De and Chattopadhyay, 2010).

Thus the phenomenon of crop diversification in India could be viewed as the survival needs of the farmers especially of the small and marginal ones. During the current decades, the process of diversification has been wide-spread due to the combined effects of water-seed fertilizer technology as well as some infrastructural development such as market centres, roads, transport etc., in the country side (Vyas, 1996; Bhalla and Singh, 1997).

## DATA AND METHODOLOGY

### Data

The present study was based on secondary data on area of 23 major crops grown in Rajasthan from various sources for 35 year from 1980 to 2014 and divided whole set of data in five periods i.e. 1980-86, 1987-93, 1994-01, 2002-

07 and 2008-14. Data collected and compiled personally by the researcher from various published sources State Offices, Libraries, Economic and Statistical Organisation of Rajasthan, Directorate of Agriculture, Rajasthan etc. These are Time series aspects of secondary data on the area of different crops was obtained from various issues of 'Rajasthan at a Glance' published by the Directorate of Economics and Statistics, Jaipur and Indian Institute of Social and Economic Change, Bangalore. Data collected and compiled of 23 major crops grown in the state of Rajasthan as given below:

**Cereals:** - wheat, paddy, bajra, sorghum, maize

**Pluses:** - gram, green gram, masur, pea, moth, cowpea

**Oilseeds:** - soybean, sesamum, ground nut, mustard and rapeseed, taramira, linseed

**Commercial Crops:** - cotton

**Horticulture Crops:** - Spices (coriander, garlic, jeera or cumin) and potato, methi

## METHODOLOGY

The methodology of the present study is consonance with the proposed objectives. Two districts namely Kota which is situated at east-south part of State and Jaisalmer which is situated at west of the Rajasthan state near to Pakistan, were selected for present study and geographical location of the both district is totally different to each other's therefore selection of both districts were more significant to measure crop diversification for comparative study. Five time periods of 1980-86, 1987-93, 1994-01, 2002-07 and 2008-14 were taken measuring crop diversification in the selected districts and separate analysis was done for all periods for both districts. Herfindhal indexes, Simpson index, Index of maximum proportion (IMP) were used to measure the crop diversification.

### Herfindahl Index (HI)

It is sum of squares of acreage proportion of each crop in the total cropped area. Mathematically, we can express this index is given as below. (Pattayanayak, 2006)

$$\text{Herfindhal index (HI)} = \sum P_i^2$$

Where,  $P_i = A_i / \sum A_i$  is the proportion of the  $i^{\text{th}}$  activity in acreage or income to the total activities

In the above formula N is the total number of crops and  $P_i$  represents area proportion of the  $i^{\text{th}}$  crop in total cropped area. In 1967 by Theil first used this index to measure the regional concentration of industries. With the increase in diversification, the Herfindhal Index would decrease. Means it's indirectly related to diversification. If value of index is one when there is complete concentration and approaches zero indicate diversification is 'perfect'. Thus the range of index is 0 to 1.

### Simpson Index (SI)

Simpson Index of diversification (SI) was used and it considered as the most suitable index for measuring dispersion of enterprises in a particular geographical region (Joshi, 2003). The mathematical formulae for calculating the index is as follows,

$$\text{Simpson Index of Diversification (SI)} = 1 - \sum P_i^2$$

Where,  $P_i = A_i / \sum A_i$  was the proportion of the  $i^{\text{th}}$  activity in acreage to the total activities

The Simpson Index of Diversification (SID) ranges from zero to one. If the estimated SID is near zero, it indicates that the district is near to the specialized in growing of particular crops. If the value is close to one, the district is fully diversified in the crops that it has grown. The decennial averages were worked out for the Simpson index computed annually for all the districts to track their average movement towards diversification or specialization

### **Index of Maximum Proportion (IMP)**

It is also inverse measure of diversification and increasing diversification IMP should decrease and the maximum share held by any activity in total income/cropped area decreases and that of other activities increase with an increase in diversification. This index is however silent about the share of other enterprises on total farm income/cropped area. The IMP is bound by zero resulting with complete diversification and to one indicating complete specialization

Index of maximum proportion= Max  $P_i$ .

## **RESULTS AND DISCUSSIONS**

If the obtained value of Herfindhal index and Index of maximum proportion ranged between 0 to 0.33 considered to be complete diversification. If the value lies between 0.34 to 0.66 it indicates moderate diversification and if the value is between 0.67 and 1.0 then it is considered as crop specialization. While value of Simpson index obtained ranged between 0 to 0.33 considered to be crop specialization. If the value lies between 0.34 to 0.66 it indicates moderate diversification and if the value is between 0.67 and 1.0 then it is considered as complete diversification

### **Herfindhal Index**

In table 1 the value of Herfindhal index were 0.9327, 0.8950, 0.5465, 0.3622 and 0.2918 for first, second, third, fourth and fifth periods in Jaisalmer district respectively, indicated crop specialization for first and second period, moderate diversification for third and fourth period, and complete diversification for fifth period. Based on these values we can conclude that Jaisalmer district is moving from specialization to complete diversification. Highest value of Herfindhal index was obtained in the first period (1980-86) while lowest was in fifth period.

Herfindhal index value for Kota district were 0.1661, 0.1541, 0.2220, 0.2637 and 0.2202 for first, second, third, fourth and fifth period respectively. Indicated crop specialization for all five periods and we can conclude that crop diversification for all period from 1980 to 2014 in Kota district is maintain but highest value of index was obtained in the fourth while lowest one was in second periods.

**Table 1: Herfindhal Index**

Districts	Herfindhal Index				
	1980-86	1987-93	1994-01	2002-07	2008-14
Jaisalmer	0.9327	0.8950	0.5465*	0.3622*	0.2918**
Kota	0.1661**	0.1541**	0.2220**	0.2637**	0.2202**

\*Indicates that there is moderate diversification, \*\*Indicates complete diversification in agriculture.

values without asterisk symbol indicate crop specialization.

### **Simpson Index**

Value of Simpson index were 0.0673, 0.1050, 0.4535, 0.6378 and 0.7082 for period first, second, third, fourth and fifth respectively, indicating crop specialization for first and second period, moderate diversification for third and fourth

period, and complete diversification for fifth period. As earlier results of indexhere also conclude that Jaisalmer district is moved from specialization to complete diversification. Highest value of Herfindahl index was obtained in the fifth period (1980-86) while lowest was in first period

Simpson index value for Kota district were 0.8339, 0.8459, 0.7780, 0.7363 and 0.7798 for first, second, third, fourth and fifth period respectively and all periods indicated complete diversification from year 1980 to 2014 in Kota district. It means we can say that farmers of Kota district were not based on some specific crop and getting benefits of crop diversification. They were diversified from cereals crop to pulse to horticultural crop like vegetables, fruits and spice. Kota and some adjoining region of Kota near to Baran district was completely diversified and getting economic benefit from this diversification in respect to their economic prosperity. Completely diversification could be due to they have adequate irrigation facilities along with good market and they have understood present demand of market. That's why they were adoptedcrop diversification from less value crop to High vale crop.

**Table 2: Simpson Index**

Districts	1980-86	1987-93	1994-01	2002-07	2008-14
Jaisalmer	0.0673	0.1050	0.4535*	0.6378*	0.7082**
Kota	0.8339**	0.8459**	0.7780**	0.7363**	0.7798**

\*Indicates that there is moderate diversification, \*\*Indicates complete diversification in agriculture.

values without astrix symbol indicate crop specialization.

### Index of Maximum Proportion

Index of maximum proportionwas calculated for both the districts separately for five period periods of 1980-86, 1987-93, 1994-01, 2002-07 and 2008-14 (Table 3). The results evident for Jaisalmer district the index value found to be 0.9322, 0.8941, 0.4978, 0.3450 and 0.2142 for the first, second, third, fourth and fifth period respectively thatindicated first and second periods show complete diversification in cropping pattern and moderate diversification for third and fourth period and complete diversification for fifth period, we can concludes that district moving from complete diversification to crop specialization. Maximum value of index (0.9322) was obtained in the first period while lowest one (0.2142) was in the fifth period.

For Kota district, value of index of maximum proportion for all five periods shows compete diversification from first to fifth period. Calculated value of index of maximum proportion was 0.0694, 0.0600, 0.0988, 0.1447 and 0.1084 for the first, second, third, fourth and fifth period respectively. Highest (0.1447) and lowest (0.0600) value were in second and fourth respectively.

**Table 3: Index of Maximum Proportion (IMP)**

Districts	1980-86	1987-93	1994-01	2002-07	2008-14
Jaisalmer	0.9322	0.8941	0.4978*	0.3450*	0.2142**
Kota	0.0694**	0.0600**	0.0988**	0.1447**	0.1084**

\* Indicates that there is moderate diversification, \*\*Indicates complete diversification in agriculture.

Values without astrix symbol indicate crop specialization.

### Compilation of Three Indices for all Periods

From the table 4 we can conclude that all three Herfindahl index, Simpson index and Index of maximum

proportion provided same results for all periods. It's supported by study of Rathod *et. al.*, 2011. Complete diversification was found in the Kota district in all period through all index and likewise in Jaisalmer district crop specialization was found in first and second period through all indices, Moderate diversification was found in third and fourth period through all indices and finally complete diversification was found in firth period through all three indices in Jaisalmer district.

**Table 4: Compilation of Three Indices for all Periods**

<b>Index</b>	<b>District</b>	<b>1980-86 (1<sup>st</sup> period)</b>	<b>1987-93 (2<sup>nd</sup> period)</b>	<b>1994-01 (3<sup>rd</sup> period)</b>	<b>2002-07 (4<sup>th</sup> period)</b>	<b>2008-14 (5<sup>th</sup> period)</b>
HI	Jaisalmer	CS	CS	MD	MD	CD
	Kota	CD	CD	CD	CD	CD
SI	Jaisalmer	CS	CS	MD	MD	CD
	Kota	CD	CD	CD	CD	CD
IMP	Jaisalmer	CS	CS	MD	MD	CD
	Kota	CD	CD	CD	CD	CD

CS: crop specialization, MD: moderate diversification, CD: Complete diversification

## CONCLUSIONS

On the basis value of above three indices Herfindahl index, Simpson index and Index of maximum proportion we can concludes that Jaisalmer district was moved from crop specialization to moderate diversification to complete diversification while in Kota district all five period from 1980 to 2014 indicated only complete diversification, But Kota district was more diversified as compare to Jaisalmer district. It might be due presence of desert or unfertile land, no adequate facilities of irrigation, low marketing and infrastructural facilities and lack of awareness of government policy and programs in Jaisalmer district. That's why still they were in crop specialization mainly they were mainly base on livestock's and its products. From the above results we can say that all indices provide the same results for the both district and it's supported by study of (Rathod *et. al.*, 2011). Geographical location of both the districts was totally different and results also vary in both. On the basis of this we can also concludes that the degree of diversification is not evenly distributed over the districts in the state. While some of the districts are picking up diversification quite rapidly others are lagging behind (supported by Bhattacharyya 2008). This might be because of the fact that even though the state or district has achieved self-sufficiency in staple food the emphasis is still focused towards increasing production of rice. Still a silent revolution is taking place and area coverage of fruits vegetables and flowers has increased substantially during the last few years. The higher returns from the high value crops therefore supports commercialisation and diversification of small farms within and outside agriculture and their proper integration with local and global markets.

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